

Ultra-Stable ALLVAR Alloy Development for Space Telescopes, Phase I



Completed Technology Project (2018 - 2019)

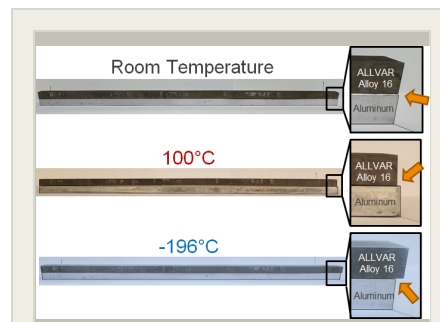
Project Introduction

This NASA SBIR Phase I proposal is in response to the need for Ultra-Stable Telescope Structures and is designed to evaluate ALLVAR Alloys for their potential as metering and support structures for optics that are critical to NASA's future missions. Telescopes used for astrophysics, exoplanet, and planetary studies require picometer stability over several minutes to hours. Building large support structures with picometer level stability is a challenge with currently available materials due to their brittle nature in the case of Zerodur and ULE or their requirement to have tight thermal control in the case of SiC or carbon fiber composites. ALLVAR Alloys offer a new material solution for thermally stable structures. They exhibit negative thermal expansion and can compensate for the positive thermal expansion of other materials to stabilize a telescope. The ultimate goal of this work is to create an ultra-stable ALLVAR Alloy metering structure manufacturing process. Bars with low thermal expansion have previously been made by welding ALLVAR Alloys to commercially available Titanium alloys, but their dimensional stability over thermal fluctuations is above the pm stability limit. This Phase I project is designed to better understand the individual stability of the titanium and ALLVAR Alloys and to evaluate hydroxide bonding for mounting mirrors to ALLVAR in preparation for pm level stability tests. The Phase II project would run full scale pm level stability tests in an effort to evaluate the relaxation manufacturing steps and understand how welding the ALLVAR Alloy to titanium may affect the material's stability.

Anticipated Benefits

A new material with picometer stability can potentially improve support structures for optic systems critical to NASA's Science Mission Directorate, like LUVIOR or HabEX. There are other potential opportunities in the manufacture of ultra-stable coronagraph hardware, support structures for deformable mirrors, telescope steering, and star tracker markets. ALLVAR metals can also be used to make balloon telescopes for exoplanet discovery and cryogenic far infrared telescopes.

ALLVAR's unique negative thermal expansion properties can compensate for thermal focus shift in refractive infrared optics used for nightvision, UVAs, missiles, and sub-sea applications. This allow infrared optics manufacturers to reduce the size and weight of their optics. ALLVAR Alloy's unique properties are also starting to get the attention of composite and glass companies. We see potential collaboration with companies in these areas for support hardware and transition piece applications.

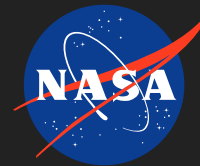


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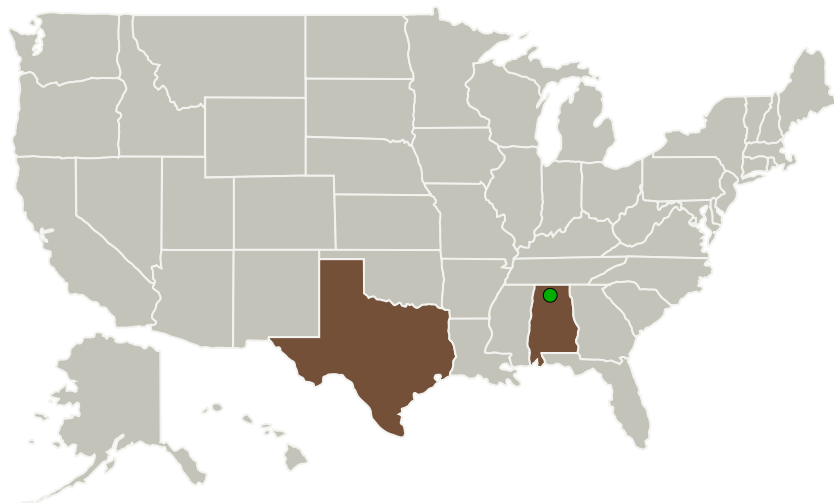
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Thermal Expansion Solutions, Inc.	Lead Organization	Industry	College Station, Texas
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	Texas
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Project Transitions

**July 2018:** Project Start**February 2019:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/140638>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Thermal Expansion Solutions, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

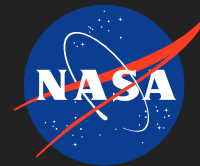
Principal Investigator:

James A Monroe

Co-Investigator:

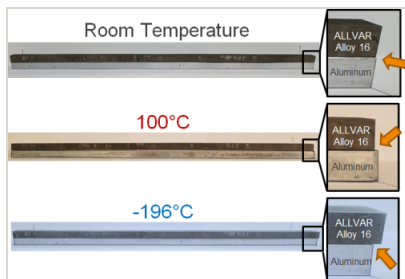
James W Monroe

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Images



Briefing Chart Image

Ultra-Stable ALLVAR Alloy Development for Space Telescopes, Phase I
(<https://techport.nasa.gov/image/134392>)

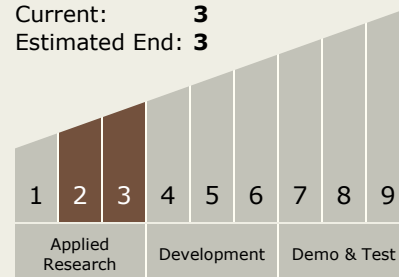


Final Summary Chart Image

Ultra-Stable ALLVAR Alloy Development for Space Telescopes, Phase I
(<https://techport.nasa.gov/image/129990>)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.2 Observatories
 - └ TX08.2.1 Mirror Systems

Target Destination

Outside the Solar System